INSTRUCTION MANUAL

Panoramic*

RANGE EXTENDING CONVERTER

MODEL REC-1

Gertsch*
EMPIRE*
Sensitive Research*
Panoramic*
SINGER

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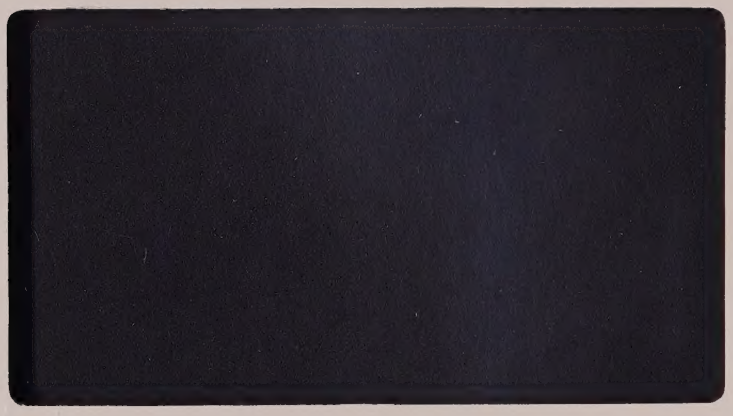
Precision electrical and electronic instruments for measurement

THE SINGER COMPANY • METRICS DIVISION



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IB5000

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*Commander** Instruments: Potentiometers, Bridges,
Volt Ratio Boxes and Standard Resistors.....5 years
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Other Electrical and Electronic Measuring Instruments.....1 year

Repair or replacement (at our option) without charge (F.O.B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuzes, lamps, thermoelements, and *RatioTran** potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

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This warranty is in lieu of all other obligations or liabilities expressed or implied and The Singer Company neither assumes, nor authorizes any person to assume for them, any other liability in connection with sales of instruments manufactured by The Singer Company, Metrics Division.

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Instruments should be returned only on prior written authorization from the Singer Representative or the factory(1). Warranty repair will be made upon written request. Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(2)
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

(1) Contact Metrics Division, Bridgeport, Connecticut for *Commander**, *Empire**, *Panoramic**, and *Sensitive Research** instruments. Contact Metrics Division, Los Angeles, California for *Gertsch** instruments.

(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

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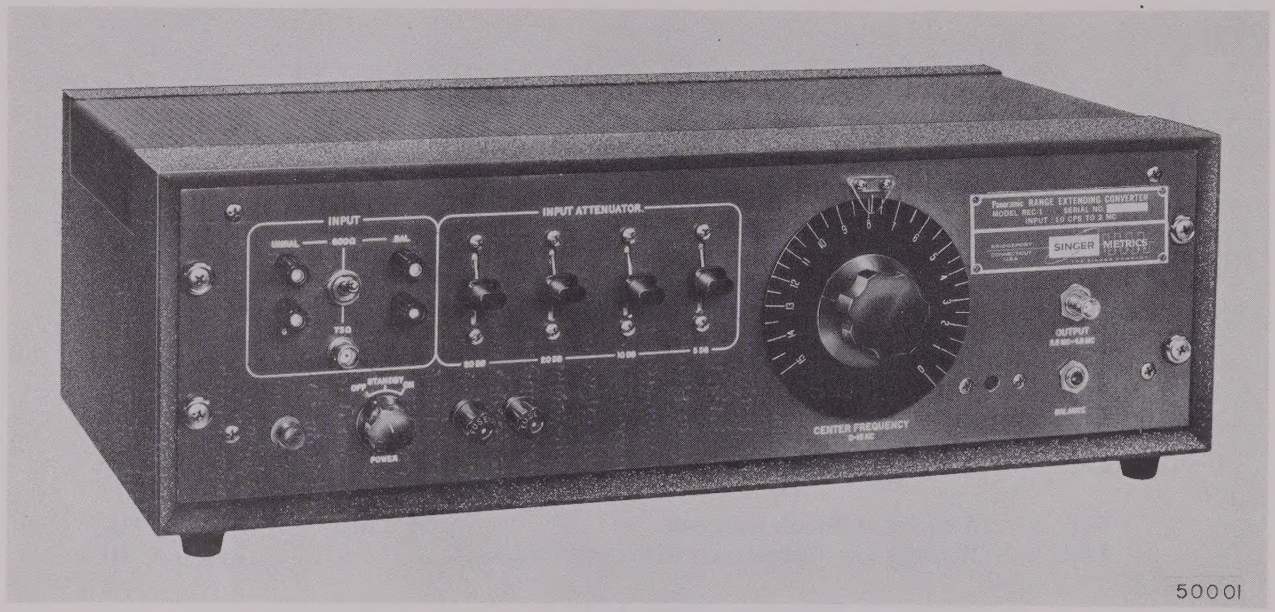

Figure 1-1. Range Extending Converter

SECTION 1

INTRODUCTION

1-1. GENERAL

This instruction manual has been prepared to assist in the installation, operation and servicing of the Range Extending Converter, Model REC-1, hereinafter referred to as the converter.

No attempt to operate the equipment should be made until the operator is thoroughly familiar with the information contained in Section 3 - Operation.

1-2. APPLICATIONS

This equipment is designed as an accessory to the Panalyzor*Model SB-12a or Model SB-12b. It can also be used with Models SB-8bZ, Type T-100 or T-200 and Model CA-5.

It allows analysis of signals in the 0 to 2 mc range on these equipments. Typical applications include:

- Audio frequency spectrum analysis
- Ultrasonic spectrum analysis
- Channel width and occupancy studies in receiver I-F stages
- Analysis of signals in the base band of telephone and telegraph carrier systems
- Single sideband receiver distortion measurements (with Two-Tone RF Generator, Model TTG-5).

1-3. EQUIPMENT SUPPLIED

Description	Quantity
Range Extending Converter, Model REC-1	1
Cable, Signal Output, #556161-401	1
Cable, VFO Input, #556161-370	1
Cable, VFO Output, #556161-370	1

1-4. GENERAL DESCRIPTION

The converter is a device used to translate the frequency spectrum between 0 to 2 mc to 2.5 mc to permit the analysis of signals by an RF spectrum analyzer having a 500 kc input center frequency such as the Panoramic* Model SB-12a, Model SB-12b, the Single Sideband Spectrum Analyzers, Models SSB-3a or SSB-3b, or the Panalyzor* Models SB-8bZ, Type T-100 or T-200.

The converter contains a balanced bridge modulator to combine the input signals and the output of a signal generator or VFO (such as the Panoramic* Models RF-7a or RF-8) to produce an output at 2.5 mc. The signal generator must operate in the 2.5 to 4.5 mc range, with an output of 0.3 volt into a 50 ohm load. The stability and freedom from incidental FM or AM modulation of the signal generator must be commensurate with the resolution capability of the associated Panalyzor*. The output of the modulator is amplified by a 2.5 mc I-F amplifier (100 kc bandwidth) and fed to the signal input jack of the spectrum analyzer. The converter also contains a 3 mc oscillator to supply the VFO input of the Panalyzor to effect a final heterodyning of the signal to a 500 kc frequency.

Switching of the signals from the signal generator and the local oscillator of the converter is accomplished by a coaxial switch activated by the power switch of the converter.

The 3 mc oscillator is tunable over a 15 kc range by means of a calibrated dial (CENTER FREQUENCY 0-15 KC), to permit identification and location of signals in this range.

The converter has three sets of inputs: 600 ohms balanced to ground, 600 ohms unbalanced to ground, and 75 ohms unbalanced to ground. The conversion gain is approximately unity with the 600 ohm balanced inputs, and is down 6 db with the 75 ohm and 600 ohm unbalanced inputs.

To prevent overdrive when using high signal levels, a balanced-H input attenuator provides up to 55 db of attenuation in 5 db steps.

1-5. ELECTRICAL CHARACTERISTICS

a. Input Frequency Range:
10 cps - 2 mc, ±1 db

Since the inputs to the converter are direct coupled, the actual low frequency limit is determined by the resolution capabilities of the associated spectrum analyzer. With the Model SB-12b analyzer, signal components as low as 10 cps can be resolved.

b. Output Center Frequency: 2.5 mc

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c. Sensitivity: 10 mv across 600 ohm balanced input for 10 mv output to spectrum analyzer (50 ohms impedance). Approximately 6 db less on 75 ohm and 600 ohm unbalanced inputs.

d. Distortion: Odd order distortion products better than 60 db below single tone level. Hum modulation less than -60 db.

e. Input Attenuator: Up to 55 db in 5 db steps. Accuracy ±10 percent.

f. Center Frequency: Tunable 0-15 kc with dial calibrated every 500 cps. Accuracy ±200 cps. External VFO tuning dial used for higher frequencies. Dial of tuning head, Model RF-7a, is calibrated for use with the converter from 0-2 mc.

g. Power Requirements: 105-125 volts, 50-400 cps. Approximately 40 watts.

1-6. PHYSICAL CHARACTERISTICS (See Figures 2-1 and 2-2.)

a. Weight: 27-1/2 lbs. (in cabinet).

b. Dimensions:

In cabinet	19-3/4" W x 10" D x 6-5/8" H
Rack Mount Style	19" W x 9" D x 5-1/4" H

Cable, Signal Output, #556161-401, RG-58/U with 1-BNC and 1-UHF connector, 6 feet long.

Cable, VFO Input, #556161-370, RG-58/U with 2 BNC connectors, 6 feet long.

Cable, VFO Output, #556161-370, RG-58/U with 2 BNC connectors, 6 feet long.

Cable, Power (integral) with three-wire AC molded plug, 5 feet long.

1-7. TUBE AND TRANSISTOR COMPLEMENT

Circuit Reference Symbol	Type	Function
V1	6J4	I-F Amplifier
V2	6CB6	I-F Amplifier
V3	6922	I-F Amplifier and Cathode Follower
V4	OA2	Voltage Regulator
V5	6AF4	Cathode Follower
Q1	2N338	3 MC Oscillator
CR1, CR3, CR5, CR7	1N128	Balanced Modulator Diodes
CR9, CR11, CR13, CR15	2F4	Coaxial Relay Rectifiers
CR17	1N2389	Rectifier, Power Supply
CR19	1N1313	Zener Regulator Diode

1-8. FRONT PANEL CONTROLS (See Figure 1-2.)

a. INPUT ATTENUATOR. This is a group of four lever type switches which provide attenuations of 20 db, 20 db, 10 db, and 5 db. When the switches are in the down position, the indicated attenuation is inserted.

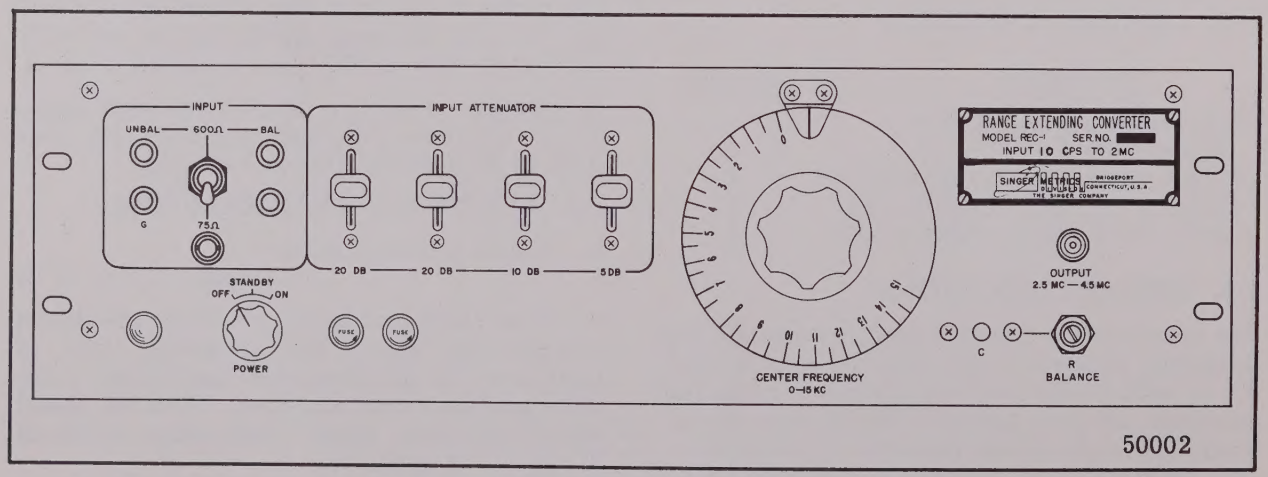

Figure 1-2. Front Panel Controls

b. INPUT. This toggle switch selects either a 600 ohm or 75 ohm input impedance. When the switch is in the 600 ohm position, either the balanced or unbalanced input terminals may be used.

c. POWER. This three position rotary switch controls the a-c power to the instrument. When the switch is in the STANDBY position, all filaments are energized but the coaxial relay bypasses the converter and connects the external VFO to the spectrum analyzer for normal operation at frequencies above 2 mc. When the switch is in the ON position, the coaxial relay is energized to connect the external VFO to the converter and connect the 3 mc oscillator of the converter to the VFO input of the Model SB-12b spectrum analyzer.

d. CENTER FREQUENCY. This calibrated dial tunes the internal oscillator from 3, 000 kc to 2, 985 kc. When frequencies in the audio range are being analyzed, the dial permits easy tuning and identification of the signals displayed on the spectrum analyzer screen. The dial may also be used as a vernier tuning control at any frequency within the range of the converter.

e. BALANCE (C-R). These screwdriver adjusted controls are accessible through holes in the front panel. They are used to balance the oscillator signal derived from the external VFO to an amplitude less than that of the signals being analyzed, in order to prevent overload of the spectrum analyzer circuits.

SECTION 2

INSTALLATION

2-1. INITIAL INSPECTION

This instrument has been tested and calibrated before shipment. Only minor preparations are required to put the instrument in operation.

The equipment is shipped with all tubes and plug-in components installed. Check to see that all such components are properly seated in their sockets.

2-2. INTERCONNECTING PROCEDURE

The converter is normally operated from a 105-125 volt, 50-400 cps single phase power source. With a suitable stepdown transformer, it may be operated from higher line voltages.

Connect the external signal generator or VFO to the BNC connector J25 (TO RF-7a) on the coaxial switch at the rear of the unit, using the 6 foot coaxial cable, 556161-370, with right-angle BNC connectors. Using the other 556161-370 cable, connect J19 (TO VFO INPUT) on the other coaxial switch to the VFO input connector on the Model SB-12a or SB-12b spectrum analyzer. If a Model SB-12as or SB-12bs analyzer is used, the OUTPUT connector of the converter is connected to the front panel analyzer SIGNAL INPUT connector, using coaxial cable 556161-401 (BNC to UHF). If the analyzer is a Model SB-12a or SB-12b, a cable with BNC connectors at both ends (not supplied) should be connected between the OUTPUT connector of the converter and the rear apron BNC VFO input of the spectrum analyzer.

Connect the converter to a source of a-c power and turn the POWER switch to ON. The click of the coaxial relay should be audible. Place the Model SB-12a or SB-12b spectrum analyzer in operation. Refer to the appropriate instruction manual for details of its operation.

Tune the VFO to 2.5 mc, with an output of 0.3 volt RMS. With all INPUT ATTENUATOR switches on the spectrum analyzer set to UP, a pip should be visible on the crt screen. Adjust the BALANCE controls of the converter for minimum pip height. For most convenient adjustment, use two screwdrivers simultaneously for C and R balance. These adjustments interact. Connect an audio signal of 10 millivolts at a frequency between 1 kc and 15 kc, to the 600 ohm balanced input of the converter. If an unbalanced signal is used, supply 20 mv to the 600 ohm unbalanced input. With the analyzer GAIN control fully clockwise, and the I-F ATTEN at 20 db, an approximately full scale (LOG) pip should appear on either side of the zero pip. The zero pip should be of lower amplitude than the signal pips.

Set the CENTER FREQUENCY dial of the converter to 0. Using an appropriate sweep width, tune the signal generator to center the zero pip on the crt screen. Set the CENTER FREQUENCY dial so that one signal pip is located at the center of the screen. The dial should indicate the frequency of the audio input signal, ±200 cps.

Operating the converter INPUT ATTENUATOR switches one at a time should reduce the signal pips by the indicated amount, which can be read on the analyzer screen.

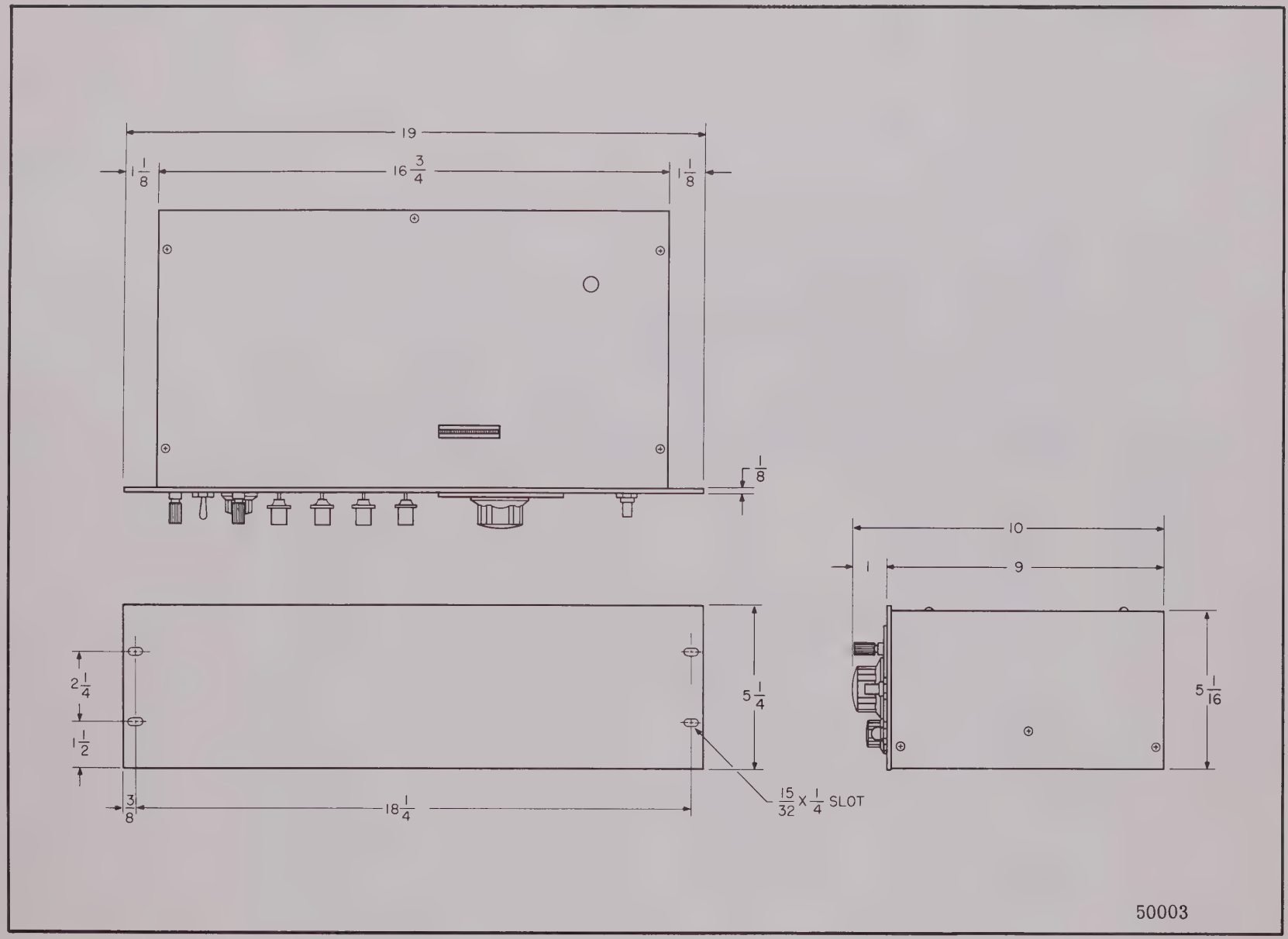

Figure 2-1. Outline Dimensional Drawing, Rack Mount Style

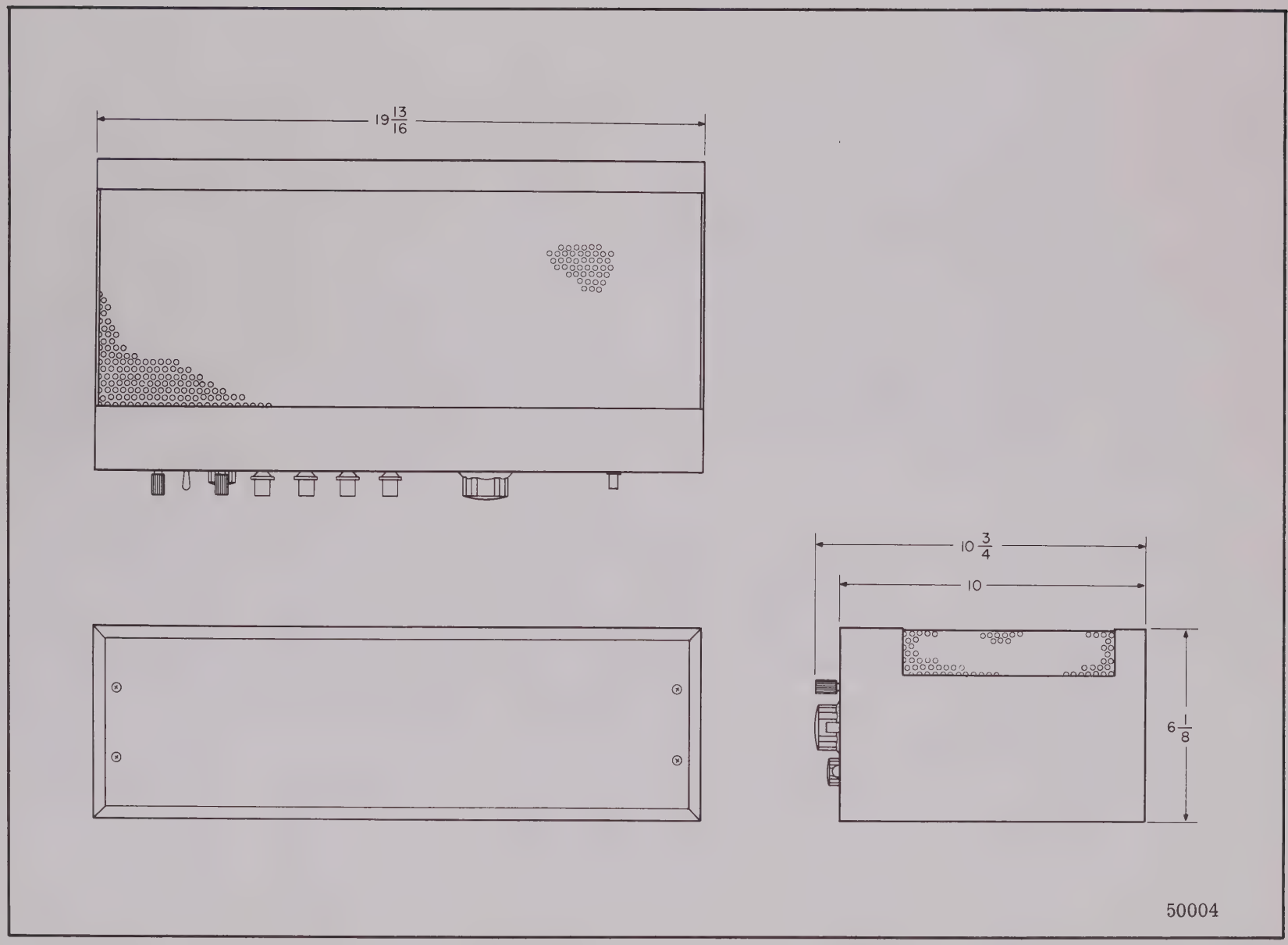

Figure 2-2. Outline Dimensional Drawing, in Cabinet

SECTION 3

OPERATION

3-1. GENERAL OPERATION

a. Turn on the power by rotating the POWER switch clockwise. When the switch is in the STANDBY position, the Model SB-12a or Model SB-12b is usable in its normal mode of operation at frequencies above 2 mc. To use the converter, turn the POWER switch to ON and connect the OUTPUT connector of the converter to the SIGNAL INPUT of the spectrum analyzer. For Panalyzor* Models SB-12aS and SB-12bS, the 556161-401 cable (BNC to UHF) supplied with the converter may be used. For Panalyzor* Models SB-12a and SB-12b, the recommended cable is RG-58/U, with BNC connectors at both ends, using the rear apron input connector of the spectrum analyzer.

b. Set the front panel controls as follows:

1. Spectrum Analyzer

SWEEP WIDTH . . . . . .VAR (100 kc)
SWEEP RATE
I-F BANDWIDTH . . . . . .As desired for suitable display
INPUT ATTENUATORS . . . . . .All UP (the INPUT ATTENUATOR of the spectrum analyzer must not be used when operating the converter.(1)
GAIN . . . . . .Fully clockwise

Other controls may be set as required for a suitable display.

2. Converter

CENTER FREQUENCY 0
INPUT switch . . . . . .As desired
INPUT ATTENUATOR. . . . . All up

3. External Signal Generator

Output level . . . . . .0.3 volt
Frequency. . . . . Signal frequency +2.5 mc

NOTE

When using the Panoramic* Model RF-7a Tuning Head, set the output level for a red line meter indication. The yellow frequency scale on the MAIN TUNING dial reads directly in signal frequency for operation with the converter.

c. Tune the signal generator to center the signal or signals on the analyzer screen. The preset sweep widths of the spectrum analyzer may be used to clarify the display. Use the INPUT ATTENUATOR of the converter to reduce the signal level (if necessary) to not more than 5 db above full scale (LOG) deflection on the analyzer screen, with the analyzer I-F ATTEN set to 20 db. The analyzer GAIN control may be used for further gain adjustment.

d. To examine signals of less than 15 kc, the CENTER FREQUENCY dial of the converter may be used for tuning. The external signal generator is set to 2.5 mc, placing the zero pip in the center of the analyzer screen. The frequency of any signal component in the range 0 to 15 kc may be determined by rotating the CENTER FREQUENCY dial to center the signal pip on the analyzer screen and reading the dial.

Another type of display which may be convenient locates the zero pip at one side of the calibrated screen, thus displaying the frequency range from zero to the sweep width of the analyzer (for example, 14 kc, 7 kc, or any desired sweep width in the VAR mode of operation).

e. All normal control functions of the spectrum analyzer (except the INPUT ATTENUATORS)(1) may be used for measurement of hum, distortion, spurious signals, etc.

(1) On Model SB-12b and SB-12bs analyzers with serial numbers of 255-XXX or 258-XXX, the INPUT ATTENUATOR can be set to attenuations up to 15 db without degrading the performance of the converter.

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SECTION 4

THEORY OF OPERATION

4-1. INTRODUCTION

As shown in the block diagram, Figure 4-1, the converter consists of the following five principal sections:

1. Input section
2. Balanced diode ring modulator
3. 2.5 mc I-F amplifier
4. 3 mc tunable oscillator
5. Power supply

The input section is provided with three input circuits. Basically, the instrument is designed to operate with a 600 ohm input, balanced to ground. The attenuator is a balanced H-type, with a maximum attenuation of 55 db. Provision is made for 600 ohm and 75 unbalanced inputs as well.

The signals are directly coupled to the diode ring modulator. The output of an external signal generator drives the modulator through a wideband RF transformer. The generator operates 2.5 mc above the signal frequency, and the difference frequency is amplified by a 3 stage bandpass I-F amplifier. A cathode follower output stage drives the 50 ohm SIGNAL INPUT of the associated spectrum analyzer.

The spectrum analyzer requires that an input signal be converted to 500 kc for display. This is done by an oscillator in the converter, tunable from 3,000 kc to 2,985 kc, which supplies approximately 0.3 volt to the VFO INPUT of the spectrum analyzer. In the OFF or STANDBY positions of the converter POWER switch, a coaxial relay connects the external signal generator directly to the VFO INPUT of the spectrum analyzer for normal operation at frequencies above 2 mc.

The power supply uses a conventional full wave silicon diode rectifier, with the voltage to the 3,000 kc tunable oscillator regulated by a voltage regulator tube and a zener diode. A bridge rectifier supplies d-c power to the coaxial relay for minimum induced hum.

4-2. CIRCUIT DESCRIPTION

a. Input Section. The signal input is through a 600 ohm balanced-H step type attenuator. Up to 55 db of loss can be inserted in the signal path in 5 db steps. The accuracy of the attenuator is ±10 percent up to 2 mc; it is not intended to be a precision device, but serves primarily to reduce input signals to levels which do not overload the following circuits and produce distortion.

For unbalanced input signals, only one side of the H attenuator is used. Matching resistors in the signal path present a 75 ohm or 600 ohm to the source. A toggle switch selects either the 75 ohm or 600 ohm unbalanced input.

b. Balanced Diode Ring Modulator. This is basically four type 1N128 germanium diodes in a ring configuration. The output of the input attenuator is coupled through a 10 db pad to one pair of terminals of the ring. The conversion signal, derived from an external generator, is coupled to the other pair of modulator terminals through a wideband balanced RF transformer, T1. The generator signal is balanced to a minimum in the output of the modulator by means of the BALANCE controls R159 and C83. These vary the resistive and reactive balance of the conversion generator signal so as to compensate for differences in diode characteristics and transformer unbalance in T1.

Exact balance of the zero signal (generator frequency) is not required. No reduction of dynamic range will occur in the associated spectrum analyzer so long as the unbalance signal is at least 10 db less than the strongest signals being analyzed.

c. 2.5 MC I-F Amplifier. The low level difference frequency signal from the diode modulator must be amplified to at least the 10 millivolt level required for full scale deflection on the spectrum analyzer crt. It is coupled from the modulator through a balanced RF transformer T3. The output of T3, which is nominally at a 75 ohm impedance level, drives a

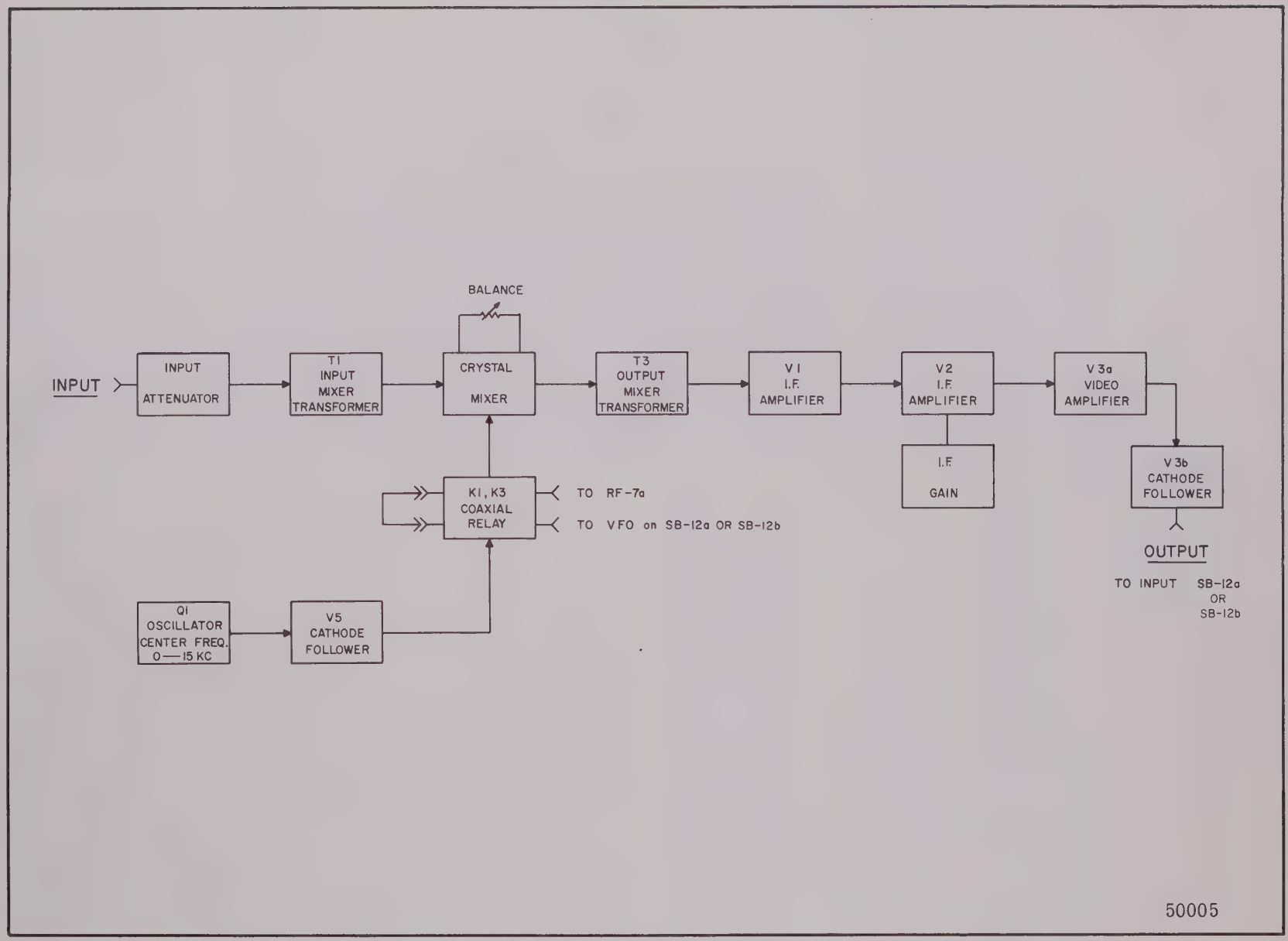


Figure 4-1. Block Diagram

low noise grounded-grid amplifier (6J4, V1). An overcoupled 2.5 mc I-F transformer T5 couples V1 to a high gain amplifier (6CB6, V2). The overall gain of the I-F amplifier is controlled by an adjustable resistor in the cathode of V2. A second overcoupled transformer couples the output of V2 to a triode amplifier (1/2 6922, V3) which is RC coupled to a cathode follower output stage (1/2 6922, V3).

The overall response of the I-F amplifier is within ±0.5 db from 2,450 kc to 2,550 kc. The 100 kc bandwidth is necessary to complement the 100 kc sweepwidth of the associated spectrum analyzer.

d. 3 MC Tunable Oscillator. A 2N338 silicon transistor (Q1) is used in a Colpitts circuit. The transistor oscillator is free from microphonics and hum modulation. It is isolated from subsequent circuits by a cathode follower (6AF4, V5) which supplies 0.3 volt to the 50 ohm VFO input of the associated spectrum analyzer. The power supplied to the transistor oscillator is regulated at approximately 8 volts by a 1N1313 zener diode.

e. Power Supply. The power supply is a conventional full wave rectified unregulated supply, using a plug-in silicon diode rectifier (1N2389, CR17). The supply voltage to the oscillator section is regulated at +150 volts by a gaseous regulator tube (0A2, V4). This regulated voltage is further stabilized at approximately 8 volts for the oscillator transistor by a zener diode (1N1313, CR19).

To keep power line hum induction at a minimum, the coils of the coaxial relay, K1 and K2, are operated from 110 volts DC. Power is obtained directly from the AC line by a silicon diode bridge rectifier (2F4, CR9, CR11, CR13, CR15) and capacitor C42. This circuit is completely isolated from the chassis to avoid a shock hazard.

SECTION 5

SERVICE AND MAINTENANCE

5-1. GENERAL

This equipment has been thoroughly tested and aligned before shipment, and with normal usage should function as described in the previous sections. However, occasional failure of a tube or component may result in malfunctioning, necessitating maintenance action or replacement.

If the equipment develops trouble which cannot be corrected by using the procedures outlined in this section, it is recommended that the instrument be returned to Singer Metrics for servicing. Before returning the instrument, send information pertinent to this Model as requested in the front of this Manual. Upon receipt of the information thereon, the company's Service Department will supply the necessary servicing data or shipping instructions. After receiving shipping instructions, forward the instrument prepaid to the factory. If requested, an estimate of charges will be made before the repair is begun.

5-2. INSPECTION AND COMPONENT REPLACEMENT

a. Inspection. All components of the equipment should be given a thorough inspection at regular intervals and whenever maintenance requires removal of an instrument from its cabinet. Moisture may cause deterioration of material and produce substandard operation. Dust and dirt materially affect both electrical and mechanical operation. Keep the various parts clean. Check accessible connections and tubes regularly to make sure that all contacts are clean and tight and that tubes and transistors are held securely in their sockets.

b. Replacement. All tubes and transistors are accessible at the top of the chassis. The modulator and relay rectifier diodes are mounted on terminal boards underneath the chassis. The pilot lamp is located on the front panel, and is removed by unscrewing. The fuses are located on the front panel.

CAUTION

Never replace a fuse with one of a higher current rating. If a fuse burns out immediately after replacement, do NOT replace it a second time until the cause has been determined and trouble is corrected.

c. Vacuum Tube Replacement. Vacuum tubes should be checked on a reliable tube tester. An indication of "GOOD" on a tube tester does not mean that a tube will necessarily function properly in its circuit, but a "REPLACE", "BAD", or borderline indication does mean that better service will generally result if the tube is replaced. The average commercial tube tester should not be called upon to give more information than this. Many questions regarding the condition of a particular tube in a given circuit can best be answered by substituting a tube known to be free from defects in its place and comparing the performance of the equipment. If the 2N338 transistor is suspected of being defective, it may be checked for shorts, opens, or current gain on a transistor checker. A more desirable check is to substitute another transistor known to be free from defects and compare the performance of the equipment.

5-3. RECOMMENDED TEST EQUIPMENT

The following equipment should be available for proper service and alignment.

a. Singer-Metrics, Model SB-12a or Model SB-12b

b. 2 Signal Generator, Singer-Metrics Model SG8 or equivalent (50 kc to 65 mc, 0.1 uv to 3 volts)

or

1 Signal Generator, Singer-Metrics Model SG8

and

1 Tuning Head, Singer-Metrics Model RF-7a (2.5 mc to 40 mc, 0.3 volt output)

c. 1 Signal Generator, Hewlett-Packard Model 200 CD or equivalent (5 cps to 600 kc, 0 to 5 volts)

d. 1 Vacuum-Tube Voltmeter, RCA Model WV-77C, AN/USM-116 or equivalent

e. 1 AC Vacuum-Tube Voltmeter, Singer-Metrics Model 9101 or equivalent (1 mv to 300 volts, 20 cps to 4 mc)

f. 1 Oscilloscope, vertical deflection sensitivity 0.05 v/cm or better, Hewlett-Packard Model 120A or equivalent

g. 1 RF Sweep Signal Generator, able to deliver output at 2.5 mc center frequency, with sweep width adjustable from 0 to 2 mc, Type CCA Q-CP-932A or equivalent. Provision for external frequency marker injection. Phasing Control.

NOTE

Conventional TV/FM service alignment generators, such as the EICO Model 360, are satisfactory for this purpose.

h. 1 Frequency Counter, maximum frequency 3 mc or higher (Berkeley Model 7370 or equivalent)

5-4. SCREWDRIVER-ADJUST CONTROLS

These controls are in circuits which seldom require adjustment. They are located on top of the chassis.

a. IF Gain. This control is adjusted for 10 millivolts output from the converter when a 10 millivolt signal is applied to the 600 ohm balanced input terminals.

b. L1 and C42. These are the frequency determining adjustments, located on the oscillator unit. They affect the calibration of the CENTER FREQUENCY dial and should not be touched unless a critical part is replaced in the oscillator section.

5-5. TUBE REPLACEMENT AND TOUCH-UP ALIGNMENT

This instrument has been factory aligned before shipment, and should not require re-alignment under normal conditions. However, it should be noted that the alignment has been made with the original set of tubes in operation; when tubes or transistors are replaced, touch-up alignment may become necessary because of non-uniformity in operating characteristics of vacuum tubes and transistors. Table 5-1 lists the recommended adjustment procedures when the indicated tubes are replaced.

TABLE 5-1. TOUCH-UP ALIGNMENT

Tube or Transistor	Adjustment
V1	T5 primary; I-F gain
V2	T5 secondary; T7 primary; I-F gain
V3	T7 secondary; I-F gain
V4	None
V5	None
Q1	C43 (oscillator trimmer)

5-6. ALIGNMENT PROCEDURE

The following is a complete factory alignment procedure. It should only be required after touch-up alignment techniques have been tried and have failed to yield satisfactory results.

a. I-F Alignment. Connect the test equipment as shown in Figure 5-1. Set the I-F gain adjustment of the converter fully clockwise. Use maximum vertical sensitivity on the oscilloscope.

b. Oscillator Alignment. Connect the input of the frequency counter to J15 (oscillator output connector). Set the CENTER FREQUENCY dial to 0 kc. Adjust the oscillator trimmer, C43, for a frequency of 3,000 kc. Set the CENTER FREQUENCY dial to 15 kc. Adjust the core of L1 for a frequency of 2,985 kc. Repeat these adjustments, successively tuning C43 and L1, until the oscillator frequency is 3,000 kc with the CENTER FREQUENCY dial at 0 kc and 2,985 kc with the CENTER FREQUENCY dial at 15 kc.

NOTE

The absolute frequency is not critical (e.g., variations on the order of 10 kc from the nominal 3,000 kc frequency are permissible). However, for correct dial calibration, the frequency change must correspond to the change in reading of the CENTER FREQUENCY dial.

c. I-F Gain. Connect the converter to its companion Panoramic spectrum analyzer and an external signal generator, and establish normal operating conditions. Adjust the BALANCE control for minimum pip height. Connect a 20 millivolt signal, within the 0 to 2 mc operating range of the converter, to its 600 ohm or 75 ohm unbalanced input terminals and adjust the equipment to display it on the screen of the analyzer.

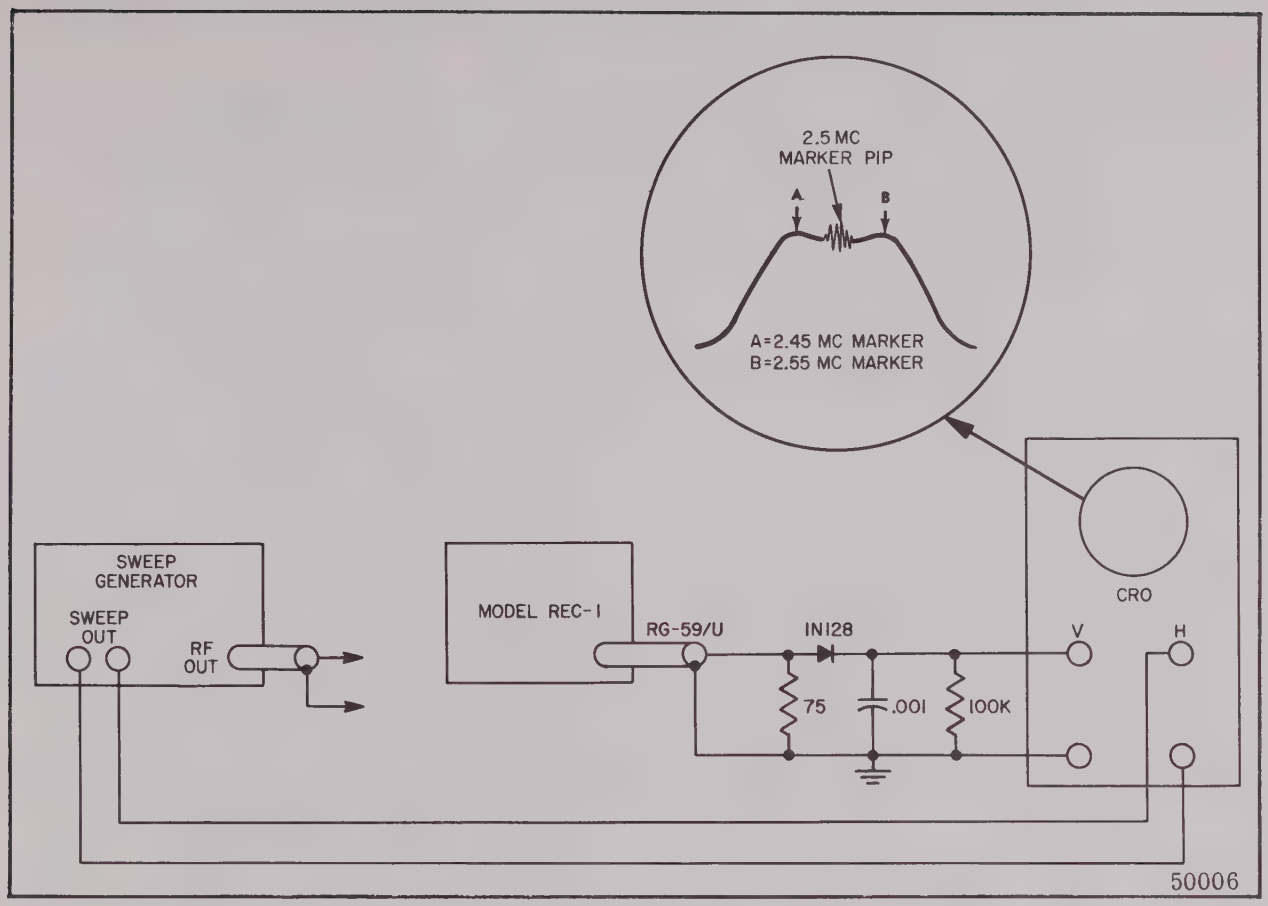


Figure 5-1. Alignment Block Diagram

Set the controls as follows:

All INPUT ATTENUATOR switches . . UP (both Model REC-1 and analyzer)[1]
Analyzer GAIN control . . . . . .Fully clockwise
Analyzer I-F ATTEN switch. . . . . .20 db
Analyzer AMPLITUDE SCALE switch . . . LOG

Adjust the I-F gain control (on the chassis) for a full scale pip on the analyzer screen.

Tune to 0 kc and observe the unbalance pip. If it is at least 10 db below the signal level, the alignment is complete. If the unbalance pip is too high, simultaneously adjust the C and R BALANCE controls on the front panel to reduce its amplitude as required.

[1]On Model SB-12b and SB-12bs analyzers with serial numbers in the 255 and 258 series, use INPUT ATTENUATOR setting of 15 db.

5-7. VOLTAGE AND RESISTANCE MEASUREMENTS

The voltage and resistance measurements shown in Figure 5-2 should be used as an aid in locating and isolating causes of equipment malfunction.

All measurements were made with an RCA Vacuum-Tube Voltmeter, Model WV-77B. The voltage and resistance readings on the chart are taken between the tube socket pin indicated and chassis ground. Resistance measurements were taken with the line cord disconnected and the POWER switch in the ON position.

Step	Sweep Gen. Output	Sweep Width (approx.)	Marker Gen. Output	Signal Fed to	Procedure
1	2.5 mc	1 mc	OFF	LUG 3 T5	Adjust generator output for full scale presentation on oscilloscope.
2	2.5 mc	1 mc	2.5 mc	LUG 3 T5	Adjust marker generator level until marker pip (birdie) is visible on display. See Figure 5-1.
3	2.5 mc	1 mc	2.5 mc	LUG 3 T5	Adjust top and bottom cores of T7 until display resembles Figure 5-1. Adjust sweep width as necessary. If a lump or dip appears near one side of the display, adjust cores of T5 to remove it.
4	2.5 mc	Same as step 3	2.45 mc	LUG 3 T5	Marker pip should appear between point A and center of display. (See Figure 5-1.) Adjust cores of T5 as necessary.
5	2.5 mc	Same as step 4	2.55 mc	LUG 3 T5	Marker pip should appear between point B and center of display (See Figure 5-1.) Adjust cores of T7 as necessary.
6					Repeat steps 4 and 5 until display resembles Figure 5-1 as closely as possible. The region between 2.45 mc and 2.55 mc should be as flat as possible (±5 percent or better).
7					If a satisfactory display centered at 2.5 mc cannot be obtained, change capacitor C17 to a slightly different value and repeat steps 3 to 6. The correct value of C17 is one which produces a symmetrical display centered at 2.5 mc.
8					If the required flatness cannot be obtained from 2.45 mc to 2.55 mc, the coupling between the windings of T7 must be changed. Remove the coil can of T7 and soften the Q-dope holding the coils in place with a suitable solvent. Change the coil spacing slightly and repeat steps 3 through 7. When the proper spacing has been determined, cement the coil slip tubes to the form with Q-dope.

Step	Sweep Gen. Output	Sweep Width (approx.)	Marker Gen. Output	Signal Fed to	Procedure
9	2.5 mc	Same as above	2.5 mc	LUG B T1	Rotate BALANCE controls (front panel screwdriver adjustments) for maximum display height on oscilloscope. Readjust output of sweep generator for full scale display.
10	2.5 mc	Same as above	2.5 mc	LUG B T1	Adjust top and bottom cores of T5 to obtain display shown in Figure 5-1.
11					Repeat procedure of steps 4 and 5, with signal injected at LUG B, T1, adjusting cores of T5 for ±5 percent or better flatness over 2.45 mc to 2.55 mc range. Some readjustment of the cores of T7 may be necessary to obtain the proper display. The bandpass region may extend appreciably beyond the required limits. Avoid unnecessarily wide bandpass response (greater than 200-300 kc).

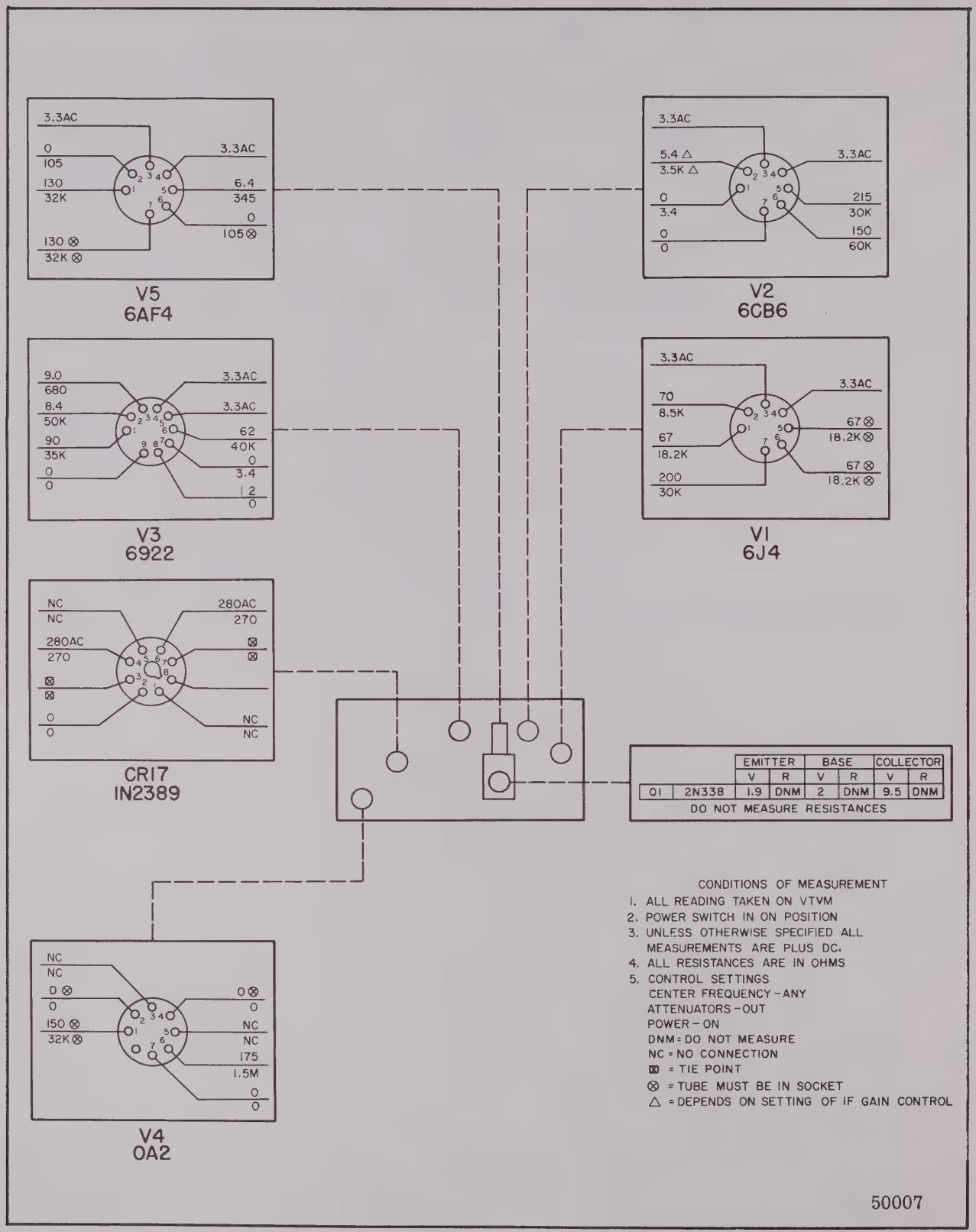


Figure 5-2. Voltage and Resistance Measurements

SECTION 6

PARTS LIST

6-1. PARTS LIST

a. Total quantities of each component used in the equipment are listed in the "QTY IN SET" column. In the case where an item appears more than once, the total quantity per equipment is listed only once. It is listed the first time the item appears.

b. The list of the Manufacturers Code used in the "MFR & MFRS NO." column which follows, is arranged in numerical sequence. The code identifies each manufacturer and his address in accordance with Federal Supply Code for Manufacturers, Cataloging Handbook H4-1.

In some cases, values, ratings, and source (manufacturer) shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement for the part removed from the equipment.

c. When ordering parts from the factory, always include the following information:

Instrument Model Number
Serial Number
Circuit Reference Symbol
Part Description (including Singer Part No.)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C1		CAPACITOR: fixed, silvered mica, 56 uuf, ±5%, Singer Part 556079-040	72136 CM15C560J	1	
C3		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 811	10	
C5		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 811		
C7		CAPACITOR: silvered mica, (1)47 uuf, ±5% nominal value, Singer Part 556079-025	72136 CM15E470J	1	
C9		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 811		
C13		CAPACITOR: fixed, ceramic, disc, 0.02 uf, 500 V, Singer Part 556060-023	56289 29C187A	4	
C15		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 811		

(1)Factory selected; see schematic diagram for actual value.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C17		CAPACITOR: fixed, silvered mica,(1)36 uuf, ±5%, Singer Part 556079-039	72136 CM15E360J	1	
C19		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 811		
C23		CAPACITOR: fixed, ceramic, disc, 0.05 uf, 500 V, Singer Part 556060-081	56289 41C105	4	
C25		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 811		
C27		CAPACITOR: fixed, ceramic, disc, 0.05 uf, 500 V, Singer Part 556060-081	72982 827200Z5UO		
C29		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 816		
C42		CAPACITOR: electrolytic, wire lead mt., 20 uf, 250 V, Singer Part 556073-002	14655 CE71A200M	1	
C43		CAPACITOR: variable, ceramic, 3-12 uuf, NPO, Singer Part 556122-030	72982 Type 557B	1	
C45		CAPACITOR: variable, 6.8-20 uuf, Singer Part 556122-060	80583 4111-7	1	
C47		CAPACITOR: fixed, silvered mica, 910 uuf(2), ±5%, Singer Part 556083-005	72136 CM20D911J	1	
C49		CAPACITOR: fixed, silvered mica, 620 uuf(2), ±5%, Singer Part 556083-002	72136 CM20D621J	1	
C51		CAPACITOR: fixed, silvered mica, 33 uuf, ±5%, Singer Part 556079-018	72136 CM15E330J	1	

(1)Factory selected; see schematic diagram for actual value.

(2)Must be char. "D" or better.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C53		CAPACITOR: fixed, silvered mica, 820 uuf, ±5%, Singer Part 556084-005	72136 CM20E821J	1	
C55		CAPACITOR: feed thru, ceramic, 1000 uuf, 500 V, Singer Part 556060-071	72982 Type X5S	3	
C57		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 811		
C61		CAPACITOR: fixed, ceramic, disc, 0.02 uf, 500 V, Singer Part 556060-023	56289 29C187A		
C63		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	7298 Type 811		
C65 A&B		CAPACITOR: electrolytic, 20-20 uf, 500 V, plug-in type, Singer Part 556070-010	56289 CE52X200S	2	
C67 A&B		CAPACITOR: electrolytic, 20-20 uf, 500 V, plug-in type, Singer Part 556070-010	56289 CE52X200S		
C69		CAPACITOR: fixed, ceramic, disc, 0.01 uf, 500 V, GMV, Singer Part 556060-073	72982 Type 811		
C73		CAPACITOR: feed thru, ceramic, 1000 uuf, 500 V, Singer Part 556060-071	72982 Type X5S		
C74		CAPACITOR: fixed, ceramic, disc, 0.05 uf, 500 V, Singer Part 556060-081	72982 827200Z5UO		
C75		CAPACITOR: fixed, ceramic, disc, 0.02 uf, 500 V, Singer Part 556060-023	56289 29C187A		
C77		CAPACITOR: fixed, ceramic, disc, 0.02 uf, 500 V, Singer Part 556060-023	56289 29C187A		
C79		CAPACITOR: feed thru, ceramic, 1000 uuf, 500 V, Singer Part 556060-071	72982 Type X5S		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C80		CAPACITOR: fixed, ceramic, disc, 0.05 uf, 500 V, Singer Part 556060-081	72982 827200Z5UO		
C83		CAPACITOR: differential 3.2-50 uuf, Singer Part 556122-110	74970 148-304	1	
CR1		DIODE: Germanium, Singer Part 556118-045	77638 1N128	4	
CR3		DIODE: Germanium, Singer Part 556118-045	77638 1N128		
CR5		DIODE: Germanium, Singer Part 556118-045	77638 1N128		
CR7		DIODE: Germanium, Singer Part 556118-045	77638 1N128		
CR9		DIODE: silicon, 400 P. I. V., 200 ma, Singer Part 556118-020	84970 2F4	4	
CR11		DIODE: silicon, 400 P. I. V., 200 ma, Singer Part 556118-020	84970 2F4		
CR13		DIODE: silicon, 400 P. I. V., 200 ma, Singer Part 556118-020	84970 2F4		
CR15		DIODE: silicon, 400 P. I. V., 200 ma, Singer Part 556118-020	84970 2F4		
CR17		RECTIFIER: silicon, plug-in type, 1N2389 Singer Part 556118-018	84970 S5251	1	
CR19		DIODE: Zener, 7.5 to 10 volt, 1N1313, Singer Part 556118-017	01281 6313	1	
DS1		LAMP: miniature, flanged base, Type 349, 6.3 V, 0.206 amp, Singer Part 556002-130	92966 349	1	
F1		FUSE: instant, 2 amp, 250 V, Singer Part 556006-018	71400 Jan F02G2R00A	2	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
F2		FUSE: instant, 2 amp, 250 V, Singer Part 556006-018	71400 Jan F02G2R00A	2	
J1		RECEPTACLE: BNC, chassis mount, D hole type, Mil Type UG-1094/U, Singer Part 556010-038	02660 31-221	2	
J3		CONNECTOR: post binding, Singer Part 556010-041	74970 "Six Way" 111-103	4	
J5		CONNECTOR: post binding, Singer Part 556010-041	74970 "Six Way" 111-103		
J7		CONNECTOR: post binding, Singer Part 556010-041	74970 "Six Way" 111-103		
J9		CONNECTOR: post binding, Singer Part 556010-041	74970 "Six Way" 111-103		
J11		CONNECTOR: receptacle, R.F., series BNC, Mil Type UG-909/U, Singer Part 556010-043	02660 31-206	1	
J15		RECEPTACLE: BNC, chassis mount, D hole type, Mil Type UG-1094/U, Singer Part 556010-038	02660 31-221		
L1		COIL: oscillator, 3 mc, Singer Part 556026-231	16665 556026-231	1	
L3		COIL: R.F., 500 uh, Singer Part 556012-022	76487 J300-500	1	
L5		COIL: R.F., fixed, 0.8 uh, Singer Part 556012-040	76493 6175-TV	2	
L7		COIL: R.F., fixed, 0.8 uh, Singer Part 556012-040	76493 6175-TV		
P1		POWER CORD: AC 3 conductor, Singer Part 556161-212	16665 556161-212	1	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
P15		CONNECTOR: plug, R.F., series BNC, angle, Mil Type UG-913/U, Singer Part 556016-104	02660 31-204	1	
P17		CONNECTOR: plug, R.F., series BNC, Mil Type UG-88C/U, Singer Part 556016-026	02660 31-002	4	
P21		CONNECTOR: plug, R.F., series BNC, Mil Type UG-88C/U Singer Part 556016-026	02660 31-002		
P23		CONNECTOR: plug, R.F., series BNC, Mil Type UG-88C/U, Singer Part 556016-026	02260 31-002		
P27		CONNECTOR: plug, R.F., series BNC, Mil Type UG-88C/U, Singer Part 556016-026	02660 31-002		
Q1		TRANSISTOR: silicon, Singer Part 556017-021	03508 2N338	1	
R1		RESISTOR: fixed, composition, 82 ohms, ±5%, 1/2 W, Singer Part 151-1003-820J	01121 EB8205	1	
R3		RESISTOR: fixed, composition, 270 ohms, ±5%, 1/2 W, Singer Part 151-1003-271J	01121 EB2715	1	
R5		RESISTOR: fixed, composition, 300 ohms, ±5%, 1/2 W, Singer Part 151-1003-301J	01121 EB3015	3	
R9		RESISTOR: fixed, composition, 1,500 ohms, ±5%, 1/2 W, Singer Part 151-1003-152J	01121 EB1525	4	
R11		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W, Singer Part 151-1003-361J	01121 EB3615	8	
R13		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W, Singer Part 151-1003-361J	01121 EB3615		
R15		RESISTOR: fixed, composition, 1,500 ohms, ±5%, 1/2 W, Singer Part 151-1003-152J	01121 EB1525		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R17		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W, Singer Part 151-1003-361J	01121 EB3615		
R19		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W, Singer Part 151-1003-361J	01121 EB3615		
R21		RESISTOR: fixed, composition, 1,500 ohms, ±5%, 1/2 W, Singer Part 151-1003-152J	01121 EB1525		
R23		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W, Singer Part 151-1003-361J	01121 EB3615		
R25		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W, Singer Part 151-1003-361J	01121 EB3615		
R27		RESISTOR: fixed, composition, 1,500 ohms, ±5%, 1/2 W, Singer Part 151-1003-152J	01121 EB1525		
R29		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W, Singer Part 151-1003-361J	01121 EB3615		
R31		RESISTOR: fixed, composition, 360 ohms, ±5%, 1/2 W, Singer Part 151-1003-361J	01121 EB3615		
R33		RESISTOR: fixed, composition, 430 ohms, ±5%, 1/2 W, Singer Part 151-1003-431J	01121 EB4315	4	
R35		RESISTOR: fixed, composition, 560 ohms, ±5%, 1/2 W, Singer Part 151-1003-561J	01121 EB5615	4	
R37		RESISTOR: fixed, composition, 560 ohms, ±5%, 1/2 W, Singer Part 151-1003-561J	01121 EB5615		
R39		RESISTOR: fixed, composition, 430 ohms, ±5%, 1/2 W, Singer Part 151-1003-431J	01121 EB4315		
R41		RESISTOR: fixed, composition, 560 ohms, ±5%, 1/2 W, Singer Part 151-1003-561J	01121 EB5615		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R43		RESISTOR: fixed, composition, 560 ohms, ±5%, 1/2 W, Singer Part 151-1003-561J	01121 EB5615		
R45		RESISTOR: fixed, composition, 180 ohms, ±5%, 1/2 W, Singer Part 151-1003-181J	01121 EB1815	4	
R47		RESISTOR: fixed, composition, 1,100 ohms, ±5%, 1/2 W, Singer Part 151-1003-112J	01121 EB1125	8	
R49		RESISTOR: fixed, composition, 1,100 ohms, ±5%, 1/2 W, Singer Part 151-1003-112J	01121 EB1125		
R51		RESISTOR: fixed, composition, 180 ohms, ±5%, 1/2 W, Singer Part 151-1003-181J	01121 EB1815		
R53		RESISTOR: fixed, composition, 1,100 ohms, ±5%, 1/2 W, Singer Part 151-1003-112J	01121 EB1125		
R55		RESISTOR: fixed, composition, 1,100 ohms, ±5%, 1/2 W, Singer Part 151-1003-112J	01121 EB1125		
R57		RESISTOR: fixed, composition, 820 ohms, ±5%, 1/2 W, Singer Part 151-1003-821J	01121 EB8215	2	
R59		RESISTOR: fixed, composition, 430 ohms, ±5%, 1/2 W, Singer Part 151-1003-431J	01121 EB4315		
R61		RESISTOR: fixed, composition, 430 ohms, ±5%, 1/2 W, Singer Part 151-1003-431J	01121 EB4315		
R63		RESISTOR: fixed, composition, 820 ohms, ±5%, 1/2 W, Singer Part 151-1003-821J	01121 EB8215		
R65		RESISTOR: fixed, composition, 180 ohms, ±5%, 1/2 W, Singer Part 151-1003-181J	01121 EB1815		
R67		RESISTOR: fixed, composition, 180 ohms, ±5%, 1/2 W, Singer Part 151-1003-181J	01121 EB1815		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R69		RESISTOR: fixed, composition, 75 ohms, ±5%, 1/2 W, Singer Part 151-1003-750J	01121 EB7505	1	
R71		RESISTOR: fixed, composition, 130 ohms, ±5%, 1/2 W, Singer Part 151-1003-131J	01121 EB1315	1	
R83		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W, Singer Part 151-1003-101J	01121 EB1015	2	
R85		RESISTOR: fixed, composition, 300 ohms, ±5%, 1/2 W, Singer Part 151-1003-301J	01121 EB3015		
R87		RESISTOR: fixed, composition, 8,200 ohms, ±5%, 1 W, Singer Part 151-1004-473J	01121 GB4735	1	
R89		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W, Singer Part 151-1003-103J	01121 EB1035	1	
R91		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W, Singer Part 151-1003-222J	01121 EB2225	2	
R93		RESISTOR: fixed, composition, 2,700 ohms, ±5%, 1/2 W, Singer Part 151-1003-272J	01121 EB2725	2	
R95		RESISTOR: fixed, composition, 300 ohms, ±5%, 1/2 W, Singer Part 151-1003-301J	01121 EB3015		
R97		RESISTOR: variable, composition, 10,000 ohms, ±10%, 2 W, linear, Singer Part 556052-005	16665 556052-005	1	
R98		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1/2 W, Singer Part 151-1003-154J	01121 EB1545	1	
R99		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W, Singer Part 151-1003-513J	01121 EB5135	2	
R101		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W, Singer Part 151-1003-222J	01121 EB2225		

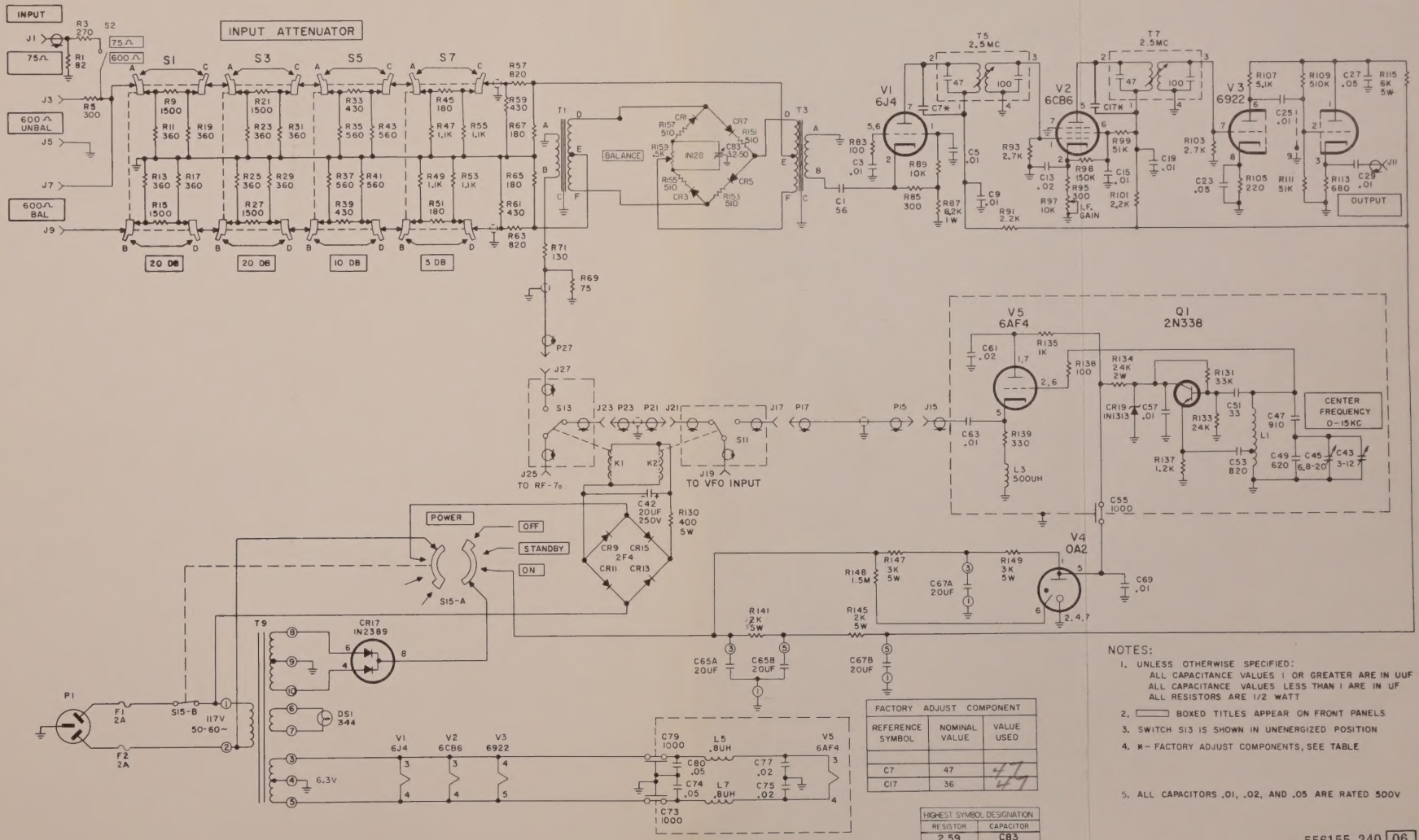
Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R103		RESISTOR: fixed, composition, 2,700 ohms, ±5%, 1/2 W, Singer Part 151-1003-272J	01121 EB2725		
R105		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W, Singer Part 151-1003-221J	01121 EB2215	1	
R107		RESISTOR: fixed, composition, 5,100 ohms, ±5%, 1/2 W, Singer Part 151-1003-512J	01121 EB5125	1	
R109		RESISTOR: fixed, composition, 510,000 ohms, ±5%, 1/2 W, Singer Part 151-1003-514J	01121 EB5145	1	
R111		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W, Singer Part 151-1003-513J	01121 EB5135		
R113		RESISTOR: fixed, composition, 680 ohms, ±5%, 1/2 W, Singer Part 151-1003-681J	01121 EB6815	1	
R115		RESISTOR: fixed, wirewound, 6,000 ohms, 5 W, Singer Part 556043-017	82807 11-4-14-6000L	1	
R130		RESISTOR: fixed, wirewound, 400 ohms, ±5%, 5 W, Singer Part 556043-027	94310 Type FRL-5	1	
R131		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1/2 W, Singer Part 151-1003-333J	01121 EB3335	1	
R133		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 1/2 W, Singer Part 151-1003-243J	01121 EB2435	2	
R134		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 2 W, Singer Part 151-1005-243J	01121 HB2435		
R135		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W, Singer Part 151-1003-102J	01121 EB1025	1	
R137		RESISTOR: fixed, composition, 1,200 ohms, ±5%, 1/2 W, Singer Part 151-1003-122J	01121 EB1225	1	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R138		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W, Singer Part 151-1003-101J	01121 EB1015		
R139		RESISTOR: fixed, composition, 330 ohms, ±5%, 1/2 W, Singer Part 151-1003-331J	01121 EB3315	1	
R141		RESISTOR: fixed, wirewound, 2,000 ohms, 5 W, Singer Part 556043-002	56289 243E2025	2	
R145		RESISTOR: fixed, wirewound, 2,000 ohms, 5 W, Singer Part 556043-002	56289 243E2025		
R147		RESISTOR: fixed, wirewound, 3,000 ohms, 5 W, Singer Part 556043-005	56289 243E3025	2	
R148		RESISTOR: fixed, composition, 1.5 megohms, ±5%, 1/2 W, Singer Part 151-1003-155J	01121 EB1555	1	
R149		RESISTOR: fixed, wirewound, 3,000 ohms, 5 W, Singer Part 556043-005	56289 243E3025		
R151		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W, Singer Part 151-1003-510J	01121 EB5105	4	
R153		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W, Singer Part 151-1003-510J	01121 EB5105		
R155		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W, Singer Part 151-1003-510J	01121 EB5105		
R157		RESISTOR: fixed, composition, 510 ohms, ±5%, 1/2 W, Singer Part 151-1003-510J	01121 EB5105		
R159		RESISTOR: variable, composition, 500 ohms, 2 W, linear, Singer Part 556052-009	16665 556052-009	1	
S1		SWITCH: lever action, 4P-2T, Singer Part 556019-142	71590 1459	4	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
S2		SWITCH: toggle, SPST, Singer Part 556019-045	04009 81015AW	1	
S3		SWITCH: lever action, 4P-2T, Singer Part 556019-142	71590 1459		
S5		SWITCH: lever action, 4P-2T, Singer Part 556019-142	71590 1459		
S7		SWITCH: lever action, 4P-2T, Singer Part 556019-142	71590 1459		
S11-K2		SWITCH: relay, coaxial, 1P-2T, BNC connectors, 120 VDC, Singer Part 556019-331	02660 315-01000-2-6	2	
S13-K1		SWITCH: relay coaxial, 1P-2T, BNC connectors, 120 VDC, Singer Part 556019-331	02660 315-01000-2-6		
S15 A&B		SWITCH: wafer, 2P-3T, one phenolic section plus a-c switch, Singer Part 556019-200	16665 556019-200	1	
T1		TRANSFORMER: wideband, 0.2 to 40 mc, Singer Part 556026-336	16665 556026-336	2	
T3		TRANSFORMER: wideband, 0.2 to 40 mc, Singer Part 556026-336	16665 556026-336		
T5		TRANSFORMER: I-F, 2.5 mc, Singer Part 556026-335	16665 556026-335	2	
T7		TRANSFORMER: I-F, 2.5 mc, Singer Part 556026-335	16665 556026-335		
T9		TRANSFORMER: power, Singer Part 556026-080	97965 PSC-55	1	
V1		ELECTRON TUBE: 6J4, Singer Part 556027-099	E.I.A. 6J4	1	
V2		ELECTRON TUBE: 6CB6, Singer Part 556027-095	E.I.A. 6CB6	1	
V3		ELECTRON TUBE: 6922, Singer Part 556027-135	E.I.A. 6922	1	
V4		ELECTRON TUBE: OA2, Singer Part 556027-003	E.I.A. OA2	1	
V5		ELECTRON TUBE: 6AF4, Singer Part 556027-066	E.I.A. 6AF4	1	

CODE LIST OF MANUFACTURERS

E.I.A.	Any E.I.A. Manufacturer
01121	Allen-Bradley Company, Milwaukee, Wisconsin
01281	Pacific Semiconductors, Inc., Culver City, California
02660	Amphenol Electronics Corp., Chicago, Illinois
03508	General Electric Company, Syracuse, New York
04009	Arrow, Hart and Hegeman Electric Co., Hartford, Connecticut
14655	Cornell, Dubilier Electric Corp., South Plainfield, New Jersey
16665	Metrics Division, The Singer Company, Bridgeport, Connecticut
56289	Sprague Electric Company, North Adams, Massachusetts
71400	Bussmann Fuse Division of McGraw Edison Co., St. Louis, Missouri
71590	Centralab Division of Globe-Union, Inc., Milwaukee, Wisconsin
72136	Electro-Motive Mfg. Co., Willimantic, Connecticut
72982	Erie Resistor Corporation, Erie, Pennsylvania
74970	E.F. Johnson Company, Waseca, Minnesota
76487	James Millen Mfg. Co., Inc., Malden, Massachusetts
76493	J.W. Miller Company, Los Angeles, California
77638	Radio Receptor Co., Inc., Brooklyn, New York
80583	Hammarlund Company, Inc., New York, New York
82807	Milwaukee Resistor Co., Milwaukee, Wisconsin
84970	Sarkes, Tarzian, Inc., Bloomington, Indiana
92966	Hudson Lamp Company, Kearny, New Jersey
94310	Tru Ohm Products Division of Model Engineering and Mfg., Inc., Chicago, Illinois
97965	Chicago Standard Transformer Corp., Chicago, Illinois



FACTORY ADJUST COMPONENT		
REFERENCE SYMBOL	NOMINAL VALUE	VALUE USED
C7	47	47
C17	36	27

HIGHEST SYMBOL DESIGNATION	
RESISTOR	CAPACITOR
2.59	C83

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITANCE VALUES 1 OR GREATER ARE IN UUF
   ALL CAPACITANCE VALUES LESS THAN 1 ARE IN UF
   ALL RESISTORS ARE 1/2 WATT
2. ▭ BOXED TITLES APPEAR ON FRONT PANELS
3. SWITCH S13 IS SHOWN IN UNENERGIZED POSITION
4. * - FACTORY ADJUST COMPONENTS, SEE TABLE
5. ALL CAPACITORS .01, .02, AND .05 ARE RATED 500V

556155-240 06

Schematic Diagram, Model REC-1